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CSCI 271

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Analysis of Spreadsheet:

Analysis of random array:

- C(n)/n: increase steadily i.e (240,964 to 5,033,418) showing C(n) grows faster than n
- C(n)/n2: Stabilizes around 0.25 (0.241 to 0.252), indicating C(n) ≈ (n^2/4) confirming the same growth rate
- C(n)/n^3: Decreases (0.000241 to 0.000013), showing C(n) grows slower than n^3
- C(2n)/C(n): Approximately 4 (3.957 to 3.995), consistent with O(n^2) as ((2n)^2 / n^2) = 4

Analysis of ascending array:

- C(n)/sqrt(n): Increases (31.606 to 141.071), showing C(n) ~ n grows faster than sqrt(n)
- C(n)/n: Stabilizes at ~1 (0.999 to 0.9999), confirming C(n) = n − 1, same growth rate.
- C(n)/n2: Decreases (0.001 to 0.000050), showing C(n) grows slower than n^2
- C(2n)/C(n): Exactly 2.000 or 2.001, consistent with C(n) = n − 1, as (2n−1)/(n−1) ≈ 2

Analysis of descending array:

- C(n)/n: Increases (499.5 to 9,999.065), showing C(n) grows faster than n
- C(n)/n2: Stabilizes at ~0.5 (0.4995 to 0.4999), confirming C(n)≈(n^2/2), same growth rate
- C(n)/n3: Decreases (0.0005 to 0.000001), showing C(n) grows slower than n^3
- C(2n)/C(n): Exactly 4.000 or 4.001, consistent with O(n^2)

Hypothesis:

- Random order (average case): $C(n) \approx (n^2/4)$, so $O(n^2)$
- Ascending order (best case): $C(n) = n - 1$, so $O(n)$
- Descending order (worst case): $C(n) = ((n-1)n/2)$, so $O(n^2)$

Justification:

- **Random Order:**
  - $C(n)/n^2$ stabilizes around 0.25, matching the expected $(n^2/4)$.
  - $C(n)/n$ increases, confirming faster growth than n
  - $C(n)/n3$ decreases, confirming slower growth than n^3
  - $C(2n)/C(n) \approx 4$ consistent with $O(n^2)$
  - The data aligns with the average-case for Insertion Sort
- **Ascending Order:**
  - $C(n)/n$ stabilizes at ~1, matching $C(n) = n-1$
  - $C(n)/spr(n)$ increases, confirming faster growth than $sqrt(n)$
  - $C(n)/n^2$ decreases, confirming slower growth than n^2
  - $C(2n)/C(n) \approx 2$ consistent with $O(n)$
  - The exact values i.e. (999 for n=1000) confirm the best-case formula
- **Descending Order:**
  - $C(n)/n^2$ stabilizes at ~0.5, matching $(n^2/2)$
  - $C(n)/n$ increases, confirming faster growth than n
  - $C(n)/n^3$ decreases, confirming slower growth than n^3
  - $C(2n)/C(n) \approx 4$ consistent with $O(n^2)$
  - The values closely follow the worst-case formula $((n-1)n/2)$ i.e. (for n=1000, $((999 \cdot 1000)/2) = 499500$ exactly matching the output).

The g(n) functions show faster, same, and slower growth, and the C(2n)/C(n) ratios confirm the complexities.